National Aeronautics and Space Administration

NASA Langley's New Method for Pitot-Static Calibration

A precise, time- and cost-effective method based on global positioning system technology using output-error optimization

NASA Langley has developed a new method for calibrating pitot-static air data systems used in aircraft. Pitot-static systems are pressure-based instruments that measure the aircraft's airspeed. These systems must be calibrated in flight to minimize potential error. Current methods that include trailing cone, tower fly-by, and pacer airplane are time- and cost-intensive, requiring extensive flight time per calibration. NASA's method can reduce this calibration time by up to an order of magnitude, cutting a significant fraction of the cost. In addition, NASA's calibration method enables near real-time monitoring of error in airspeed measurements, which can be used to alert pilots when airspeed instruments are inaccurate or failing. Because of this feature, the technology also has applications in the health usage and monitoring (HUMS) industry. Flight test engineers can be trained to use this method proficiently in 1–2 days without costly specialized hardware.

Benefits

- Reduces in-flight time required to collect data sets by up to an order of magnitude, as compared to other existing methods
- Accurately characterizes airspeed measurement error
- Collects end-to-end airspeed error measurement in near real time, which can alert pilots when instruments are inaccurate or failing
- Reduces calibration costs

partnership opportunity

Langley Research Center

The Technology

NASA Langley's method for pitot-static calibration is a novel application of modern system identification methods for in-flight airspeed calibration. True airspeed is calculated using measurements from a global positioning system (GPS) by vector summing of ground speed and estimated wind speed. This value is used to estimate actual impact pressure, which is compared with the impact pressure measured by the flight instrumentation for a range of airspeeds. The difference between these values is the error in impact pressure measurements. The optimization process calculates a mathematical model of the pressure error as a function of calibrated airspeed and an estimate of the wind speed and direction. A statistically based maximum likelihood method known as output-error is used to estimate the parameters describing the pressure error model and the wind vector values. This method can work with any airplane with a digital flight data system. A diagram of the method is in the figure below.

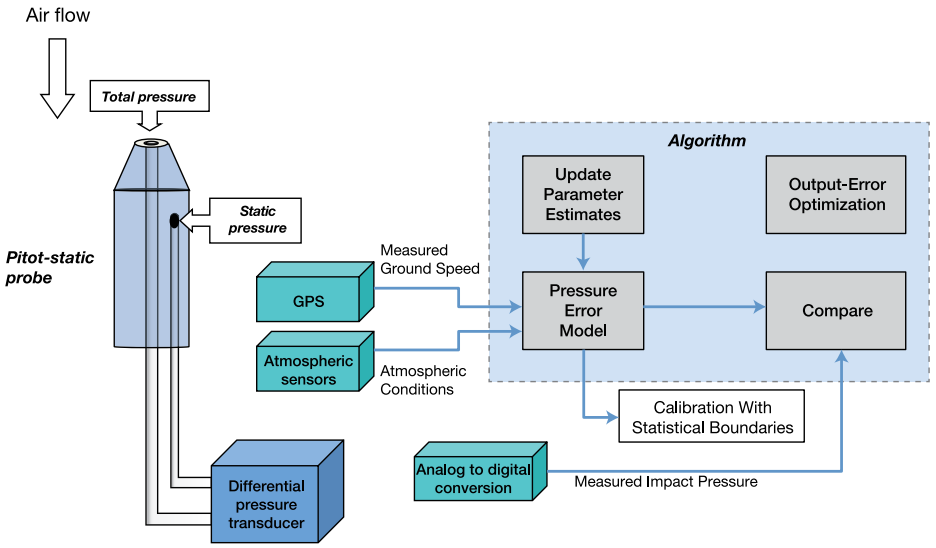

Figure 1. Output-error method for measuring airspeed error in air-data systems

Applications

Tailorability of the materials allows for innovation of new products:

- Aerospace – Replacing current legacy pitot-static calibration methods
- Aerospace health usage and monitoring systems – Measuring error in airspeed instruments in near real time to improve air safety

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

The Technology Gateway

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